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INTRODUCTORY REMARKS FROM THE ARTICLE, "A NEW METHOD FOR INVESTIGATING RELAXATION PROCESSES AND ITS USE IN STUDYING CERTAIN PHYSICAL PHENOMENA"

N. A. Tolstoy
P. P. Feofilov

Relaxation phenomena are classified as "very fast" (0 to 10^{-7} sec), "fast" (10^{-7} to 10^{-1} sec), and "slow" (10^{-1} to 10 sec).

This article is devoted to the problems of procedure in studying "fast" (10^{-7} to 10^{-1} sec) relaxation. In the actual tests, the authors succeeded in covering only the interval 10^{-5} to 10^{-1} sec for light (illumination) excitation and the interval 10^{-3} to 10^{-1} sec for electrical.

Fast processes are connected with very important phenomena in: semiconductors (photoconductivity, valve [tube] photoeffect, unipolar conductivity); crystallophosphors; photocathodes, X-ray and radio-luminescence; dielectrics (relaxation polarization); colloid solutions (anisotropy induced by external fields, electrophores, etc.); electrolytes (Becquerel's photoelectric effect); solid and liquid solutions (prolonged fluorescence); gases (gaseous discharge accompanied by the formation of metastable atoms and ions); surfaces (evaporation of ions); fast-relaxation mechanical systems (stress relaxation in polymers), etc.

This article considers the diverse methods that can be employed to investigate relaxation in the above-mentioned phenomena in the section on application of the method.

The input excitation is in the form of a Π-pulse, which gives the simplest possible transition from one constant condition to another. The resulting response (output) is represented on an oscillograph screen.

The essence of the new method is the use of "functional" time ($f(t)$) scales instead of the usual "linear" one (t), which causes the curve to lie close, i.e., asymptotically, to the vertical and time axes. The "functional" time initially flows quickly and then gradually more slowly. It is assumed that the linear time scale is extraneous to the specific nature of relaxation processes.

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Thus, complex unknown relaxation processes are studied in "asymptotic time coordinates" created by known processes. Two methods are employed: (1) method of rectification (integration) and (2) method of partial times, which permit one to obtain various exponential developments of time instead of linear ones (e.g., exp — t/RC, etc.).

It must be remembered that a physical system in a state of equilibrium represents a "balanced" or "average" picture the details of which are blurred. It is only during a transition from one equilibrial state to another that the hidden mechanism is revealed temporarily, i.e., during the relaxation interval. Hence follows the importance of relaxation phenomena.

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